

## PATENT COOPERATION TREATY

## PCT

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference sr1	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/FI2003/000814	International filing date (day/month/year) 04-11-2003	Priority date (day/month/year) 05-11-2002
International Patent Classification (IPC) or national classification and IPC G01B 11/30, G01N 21/17, G01N 21/84		
Applicant SR-INSTRUMENTS OY et al		

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 6 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
  - ☒ (sent to the applicant and to the International Bureau) a total of 5 sheets, as follows:
    - ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) \_\_\_\_\_, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

## 4. This report contains indications relating to the following items:

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Box No. I  | Basis of the report   |
| <input type="checkbox"/> Box No. II            | Priority  |
| <input type="checkbox"/> Box No. III           | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability  |
| <input type="checkbox"/> Box No. IV            | Lack of unity of invention  |
| <input checked="" type="checkbox"/> Box No. V  | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input checked="" type="checkbox"/> Box No. VI | Certain documents cited   |
| <input type="checkbox"/> Box No. VII           | Certain defects in the international application  |
| <input type="checkbox"/> Box No. VIII          | Certain observations on the international application   |

Date of submission of the demand  08-03-2004	Date of completion of this report  20-01-2005
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer  Ender Dag / itw Telephone No. +46 8 782 25 00

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International Application No.

PCT/FI2003/000814

## Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

- ☐ This report is based on a translation from the original language into the following language \_\_\_\_\_, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on (replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):

- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1-25 \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the claims:
- pages \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ as amended (together with any statement) under Article 19
- pages\* 1-5 \_\_\_\_\_ received by this Authority on 09-07-2004
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the drawings:
- pages 1-8 \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (specify): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (specify): \_\_\_\_\_

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (specify): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (specify): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

**Box No. V** Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

Novelty (N)	Claims	<u>1-22</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-22</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-22</u>	YES
	Claims		NO

## 2. Citations and explanations (Rule 70.7)

**Documents cited in the International Search Report:**

D1: US 4937449 A  
D2: GB 2371111 A  
D3: DE19913929 A1  
D4: US 5991046 A  
D5: DE 19524036 A1  
D6: EP 1367385 A1 (Published 03-12-2003)

Documents D3-D5 represents the state of the art.

The applicant describes that there are several disadvantages with prior art systems. Prior art optical and inspection methods are sensitive to ambient light, optical and electrical noise and the level of signal strength is typically also a problem. The present invention is intended to relieve and remove some of these problems.

Document D1 shows an optical measurement and inspection method and arrangement, where variations in thickness as well as casting errors may be dependently determined and evaluated. Two light sources (2, 2') transmit modulated IR light wherein the modulation frequencies are different. The light from the two light sources is conducted to a photo-receiver (3). The current signal arising in the photo-receiver is transformed into a current signal and a separate evaluation of the received light signals is possible. Evaluation may occur as a formatted expression of error, in the form of regulating signals or given to other computers for further static processing (see column 4, lines 44-48).

.../...

## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

D2 shows a sample (7) that is investigated using a beam of radiation from a source (1) and a detector (2) for detecting the radiation reflected or transmitted by the sample. Both the source and the detector may be provided with a synchronized clock signal. The phase difference introduced by the sample can be determined, and synchronization of the emission and detection of light beams may be made.

D1 represents the closest prior art document. The difference between D1 and the claimed invention, according to claims 1 and 13, is that the claimed is sending at least one signal generator to a light emitter and a light receiver and thereby synchronises the emission and detection of light. The problem of having disturbances and resist intense ambient light is reduced. The emitted ray of light follows a carrier waveform signal and the received light ray is demodulated from the carrier waveform signal using the synchronisation signal.

The problem to be solved is to from at least one signal generator synchronise the emission and detection of light by modulate with two sources of different frequencies. D2 shows an optical reference beam prone to ambient light for synchronisation, which does not pass through the sample and which is phase related to that of the beam of irradiating radiation.

The problem to be solved in D2 does not address the same problem to be solved in the claimed invention. D2 describes the use of optical reference beam which is prone to ambient light, which is an original problem of mentioned prior art. However, D2 does not refer to similar optical synchronisation of reference beam.

The problem of the claimed invention is resistant to intense ambient light and noise, which inspects sheets of material continuously without incremental integration and without losing information.

Hence it is not obvious for a person skilled in the art to modify D1 with help from D2 to solve the same problem as referred to in the claimed invention.

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**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.  
Continuation of: Box V

The invention according to claims 1-22 is novel, industrial applicable and is considered to involve an inventive step.

**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**

International application No.

PCT/FI2003/000814

**Box No. VI Certain documents cited**

**1. Certain published documents (Rule 70.10)**

Application No. Patent No.	Publication date (day/month/year)	Filing date (day/month/year)	Priority date (valid claim) (day/month/year)
EP 1367385 A1	03/12/2003	31/05/2002	

**2. Non-written disclosures (Rule 70.9)**

Kind of non-written disclosure	Date of non-written disclosure (day/month/year)	Date of written disclosure referring to non-written disclosure (day/month/year)

**AMENDED PATENT CLAIMS 7/7/2004**

1. An optical measurement and inspection method comprising at least two light emitters, at least one light receiver, at least one signal generator connected to at least one light emitter and at least one light receiver and means for converting the received light to electrical current, **characterised in that,**

- a sheet of material lies or traverses between and/or in front of at least two light emitters and at least one light receiver (200),
- at least one signal generator controls at least one light emitter and at least one light receiver by sending them an electronic synchronisation signal and thereby synchronises the emission and detection of light rays (205, 215, 245),
- at least one signal generator drives at least two light emitters with different carrier frequencies waveforms and/or phases, and at least one light receiver with both of these frequencies, waveforms and/or phases,
- at least two light emitters emit at least two rays of light (220),
- at least two rays are incident on the stationary or traversing sheet (225),
- at least two grazing, transparent and/or reflected rays of light from the sheet or directly from the light emitters are detected by the same light receiver (230),
- the intensity of at least one said emitted ray of light follows a carrier waveform signal and at least one received light ray is demodulated from the carrier waveform signal using the electronic synchronisation signal,
- at least two rays of light are converted to photocurrent (240),
- the processed photocurrent and/or changes in the processed photocurrent are diagnosed and observed to find defects and/or determine characteristics of the said sheet of material (250).

2. An optical measurement and inspection method in accordance with claim 1, **characterised in that,** different beams from different emitters targeted to the same receiver measure different properties of the material sheet.

3. An optical measurement and inspection method in accordance with claim 1, **characterised in that**, the three dimensional structure of a defect is detected with more than one beams.
4. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, at least one carrier waveform signal is a sine wave, cosine wave, or a square wave signal.
5. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, the photocurrent is converted to voltage.
6. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, resulting photocurrent or voltage is amplified.
7. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, the resulting photocurrent or voltage is fed into a fault detection circuit (80) that comprises,
- means for summing 820, 823 a positive or negative threshold voltage value to the voltage signal entering the fault detection circuit,
  - a low pass filter signal path (825),
  - means for resetting the circuit (850).
- means for generating digital defect signal pulses 840, 843 when analog signals exceeding preset threshold values are produced by the demodulation- or synchronised detection circuitry of the inspection or measurement system,
8. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, the sheet material (410, 510, 610, 710) is paper, steel, plastic, metal, rubber, aluminium foil, copper foil, film, or coated metal sheet.
9. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, the location and/or size of at least one defect and/or other attributes of at least one defect and/or sheet width, thickness, length, density, reflectivity, purity or other physical attributes of the sheet are derived from the said optical measurements.
10. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, one or more defects may feature aspects of the following: holes, pinholes, scratches, spots, stains, cracks, edge faults, streaks, surface faults.

11. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, at least one light detector (520, 570, 720) and/or detector module (430, 560, 630) and/or detector array (420, 620) comprises at least one photoelectric device (530, 730), lens (550, 750) and/or wave guide (540, 740).

12. An optical measurement and inspection method in accordance with claim 1 **characterised in that**, the signal generator drives at least two light receivers with different carrier frequencies, waveforms and/or phases.

13. An optical measurement and inspection arrangement, comprising at least two light emitters, at least one light receiver, at least one signal generator connected to at least one light emitter and at least one light receiver and means for converting the received light to electrical current, **is characterised in that**,

- a sheet of material (410, 510, 610, 710) is arranged between and/or in front of at least two light emitters (400, 500, 600, 700) and at least one light receiver (420, 520, 620, 720),

- at least two light emitters (400, 500, 600, 700) are arranged to emit at least two rays of light incident on at least one sheet,

- said at least two grazing, transparent and/or reflected rays of light are arranged to be detected by the same light receiver (420, 520, 620, 720),

- at least one ray of light is arranged to be converted to photocurrent by at least one photoelectric device (530, 630, 730)

- at least one signal generator is arranged to control at least one light emitter (400, 500, 600, 700) and at least one light receiver (420, 520, 620, 720) by sending them an electronic synchronisation signal and thereby synchronises the emission and detection of rays,

- at least one signal generator is arranged to drive at least two light emitters with different carrier frequencies, waveforms and/or phases, and at least one light receiver with both of these frequencies waveforms and/or phases,

- the intensity of at least one said emitted ray of light is arranged to follow a carrier waveform signal and at least one received light ray is arranged to be demodulated from the carrier waveform signal using the electronic synchronisation signal,

- the photocurrent and/or changes in photocurrent are arranged to be diagnosed and observed to find defects and/or determine characteristics of the said sheet of material (310).

14. An optical measurement and inspection arrangement in accordance with claim 13 **characterised in that**, different beams from different emitters arranged to be targeted to the same receiver are arranged to measure different properties from the material sheet.

15. An optical measurement and inspection arrangement in accordance with claim 13 **characterised in that**, the three dimensional structure of a defect is arranged to be detected with more than one beams.

16. An optical measurement and inspection arrangement in accordance with claim 13 **characterised in that**, at least one waveform signal is a sine wave, cosine wave, square wave -signal.

17. An optical measurement and inspection arrangement in accordance with claim 13 **characterised in that**, the resulting photocurrent or voltage is fed into a fault detection circuit (80) that comprises,

- means for summing a positive or negative threshold voltage value to the voltage signal entering the fault detection circuit 820, 823.

- a low pass filter signal path (825),

- means for resetting the circuit (850).

- means for generating digital defect signal pulses 840, 843 when analog defect signals exceeding preset threshold values are produced by the demodulation- or synchronised detection circuitry of the inspection or measurement system.

18. An optical measurement and inspection arrangement in accordance with claim 13 **characterised in that**, the sheet material (310, 410, 510, 610) is paper, steel, plastic, metal, rubber, aluminium foil, copper foil, film or coated metal sheet.

19. An optical measurement and inspection arrangement in accordance with claim 13 **characterised in that**, the location and/or size of at least one defect and/or other attributes of at least one defect and/or sheet width, thickness, length, density, reflectivity, purity or other physical attributes of the sheet are derived from the said optical measurements.

20. An optical measurement and inspection arrangement in accordance with claim 13 **characterised in that**, one or more defects may feature aspects of the following: holes, pinholes, scratches, spots, stains, cracks, edge faults, streaks, surface faults.

21. An optical measurement and inspection arrangement in accordance with claim 13 **characterised in that**, at least one light receiver and/or detector (420, 520, 560, 570, 620,

630, 720) comprises at least one photodetector (530, 730), lens (550, 750) and/or wave guide (540, 740).

22. An optical measurement and inspection method in accordance with claim 13 **characterised in that**, the signal generator is arranged to drive at least two light receivers with different carrier frequencies, waveforms and/or phases.